Reviewer 1:

We sincerely thank the reviewer for the very positive assessment and the helpful comments, which improved the clarity of the manuscript.

In addition to addressing the specific reviewer comments, we have incorporated new $PI^{14}C$ measurements from the Rhône River (Appendix A) and sediment core GEN22-04 (now included in the Results, Section 3.3, and discussed in Section 4.2). These data provide further constraints on long-term PIC preservation and complement the trap-based flux observations.

Below we address each point in turn and indicate the corresponding changes made to the manuscript.

L138. Should this be C2?

We thank the reviewer for catching this and corrected C" to C2.

L164. Is there an advantage to using a flat distribution for the source end member (DIC) and a normal distribution (PIC) for the samples in the Monte Carlo simulation? If not, a sentence on the justification of this approach here would be useful.

For the DIC endmember, we applied a flat distribution to reflect the observed range across multiple measurements and depths. Because the values span a range without a clear justification for representing them as a mean with standard deviation, we chose to sample uniformly across the entire observed range. This avoids imposing an artificial Gaussian structure that is not evident. In contrast, a normal distribution was applied for PIC samples, as these are based on single measurements with well-defined, normally distributed analytical uncertainties. We have adjusted line 164 to read:

"Monte Carlo simulations (n = 100,000) were performed, drawing $DI^{14}C$ from a flat distribution within the observed range, **as these values bound an interval without clear justification for a Gaussian distribution**, and $PI^{14}C$ from a normal distribution centered on the observed values with their measurement uncertainties."

Section 4.3. Are the values calculated here just scaled based on the surface area of the lake? I appreciate that this is delineated as a first order estimate, but is a simple areal scaling of these values appropriate? Some clarification/justification here would be appreciated to add a bit more veracity to this section, which is important to clarify the importance of the study's findings.

We thank the reviewer for pointing out the need to clarify the assumptions of our lake-wide upscaling. We have now emphasized that the extrapolations made are based on areal scaling and should be regarded as order-of-magnitude estimates. We further highlight that the lower bound is conservative, since calcite burial tends to be higher in shallower areas. Lastly, we note that the proximal trap appears representative for the delta region because the upscaled allo. POC flux agrees well with independently measured Rhone input estimates. These clarifications have been added to Section 4.3.

Reviewer 2:

We sincerely thank the reviewer for the detailed and constructive feedback, and for the very encouraging assessment of our work.

In addition to addressing the specific reviewer comments, we have incorporated new $PI^{14}C$ measurements from the Rhône River (Appendix A) and sediment core GEN22-04 (now included in the Results, Section 3.3, and discussed in Section 4.2). These data provide further constraints on long-term PIC preservation and complement the trap-based flux observations.

Below, we address the reviewer's specific comments point by point and describe the corresponding revisions made.

Major Comments

Line 121: Were dissolution rates of settling calcite crystals considered? If estimable, could this affect the study's conclusions?

We thank the reviewer for raising this important point. Previous research in Swiss hardwater lakes has shown that dissolution of authigenic calcite particles in the water column is minimal, owing to their rapid settling velocity and the generally high DIC saturation (Müller et al., 2006; Müller et al., 2015). The sediment traps therefore provide a good estimate of the PIC flux to the sediment–water interface, where dissolution is more likely to occur. The effect of this is further investigated with the sediment core.

We have included lines 355 onwards:

Water-column dissolution of calcite particles in Swiss hardwater lakes is minimal, and dissolution rather occurs in the shallow sediment−water interface, driven by pH changes through organic matter decomposition (Müller et al., 2016; Müller et al., 2006). Consequently, our deep sediment traps provide accurate estimates of PIC flux to the sediment.

Line 154: The assumption that "PICAuto was assumed to derive from the lake's DIC pool" excludes any calcite formation in the Rhône or other tributaries. Please clarify why this possibility was ruled out.

Previously, this assumption was mainly based on existing research, such as the study by Escoffier et al. (2022), who performed SEM microscopy of calcite particles from the Rhone River and found no evidence for authigenic precipitation. However, we were now also able to analyze three samples of suspended Rhone River sediment for the 14C content of PIC. We found that Rhone PIC was virtually devoid of 14C, close to the detection limit, with signatures of –992 ± 1 ‰ (07/23), –985 ± 1 ‰ (04/23), and –981 ± 1 ‰ (07/21). We could thus successfully support our assumption that PIC_{Auto} derives from in-lake DIC precipitation. We have added a clarifying sentence in the Methods (line 161 onwards)

PICAllo from the Upper Rhône River was previously estimated to be purely detrital based on δ13C signatures (Aucour et al., 1999) and SEM microscopy of PIC (Escoffier et al., 2022). This assumption is further supported by 14C analysis of three riverine PIC samples (Appendix A) which yielded virtually 14C free results.

and provide further details in Appendix A (Lines 425 onwards).

To better constrain the riverine PIC endmember, we analyzed the PI14C signature of three Rhône River suspended sediment samples, collected ant the Porte du Scex NADUF station in Summer 2023, Spring 2023 and Summer 2021, using the protocol described by (Rhyner et al., 2023). All samples gave virtually 14C free results with Δ14C of –992 ± 1 ‰ (July 2023), –985 ± 1 ‰ (April 2023), and –981 ± 1 ‰ (July 2021).

Lines 168–169: It appears the potential lateral transport of allochthonous material from the Rhône to the distal trap was not accounted for. How can we be confident that a significant portion of allochthonous POC is not laterally transported? Given the overlap between riverine particle input and peak primary productivity, please justify this methodological assumption and discuss any potential implications for the results and their interpretation.

We thank the reviewer for this comment. We provide three arguments for why the lateral transport of Rhone-derived POC to the distal trap is not significant: (1) PO14C in the distal trap matches very closely the DI14C and is much less depleted than in the proximal trap, which is influenced by depleted riverine input. The short winter period with slightly lower PO14C coincides with minimal flux in the distal trap and is thus not quantitatively important. (2) Upscaling the proximal POC_{Allo} flux to the riverine load reproduces Rhone-derived POC delivery reasonably well, suggesting that no major deposition is missed. (3) δ13C values at the distal trap are generally below –28‰, typical of lake aquatic organic matter (Randlett et al., 2015), except for October–December 2022. These less depleted values could be explained by increased remineralization after longer water column residence during convective mixing and do not indicate a systematic riverine contribution. We have added line 311:

This interpretation is further supported by the δ13C values (< −28 in most periods) in the distal trap, characteristic of lacustrine organic matter (Randlett et al., 2015).

Generally, a significant deposition of POC_{Allo} (which we rule out based on the evidence presented), would lead to an underestimation of the POC_{Allo} deposition not only in the distal trap, where it is not considered at all, but also in the proximal trap, where the distal flux is used as endmember for the POC_{Auto} flux. This would result in an even higher POC_{Allo} flux in the upscaling and a slightly younger average 14C signature of that POC_{Allo}.

Figure 4: Could the authors explain the abrupt increase in ΔPI14C observed in December 2022?

We thank the reviewer for highlighting this observation. We note that this period corresponds to the lowest PIC flux observed in the time series at both sites. Under these conditions, the PI14C signal becomes highly sensitive to even small variations in the relative contributions of authigenic and detrital PIC. We interpret the increase as a flux-driven effect: with very low overall PIC deposition, even a moderate authigenic component is enough to impact the isotopic signature strongly. L229 now reads:

This least depleted period in December 2022, however, coincides with the lowest PIC flux in the time series, making the isotopic signal highly sensitive to even small variations in source contributions.

Minor Comments

Line 300: Please specify “calcite precipitation events” to avoid confusion with meteorological precipitation.

We thank the reviewer for pointing this out, as the line in fact does relate to meteorological precipitation. We have changed the wording to “rainfall events”.

Line 311: Regarding "such as May 2023," is there supporting data or a reference confirming elevated primary productivity during this period?

Chlorophyll A concentrations at the LéXPLORE platform show a strong increase, indicative of a phytoplankton bloom during that time, available at: www.datalakes-eawag.ch/datadetail/666

We have added:

,as recorded by Chlorophyll A monitoring at LéXPLORE (Datalakes/EAWAG),

to line 311.

Further, we have provided the link to the Datalakes portal in the data availability statement.

References

Escoffier, N., Perolo, P., Lambert, T., Rüegg, J., Odermatt, D., Adatte, T., Vennemann, T. and Perga, M.E., 2022. Whiting events in a large peri-alpine lake: Evidence of a catchment-scale process. *Journal of Geophysical Research: Biogeosciences*, *127*(4), p.e2022JG006823.

Müller, B., Meyer, J.S. and Gächter, R., 2016. Alkalinity regulation in calcium carbonate-buffered lakes. *Limnology and Oceanography*, *61*(1), pp.341-352

Müller, B., Wang, Y. and Wehrli, B., 2006. Cycling of calcite in hard water lakes of different trophic states. *Limnology and Oceanography*, *51*(4), pp.1678-1688.

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